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AUTHOR Nagel, Stuart S.
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ABSTRACT

Policy analysis, or policy study, is defined as the study of the nature, causes, and effects of alternative public policies: sometimes policy analysis refers to specific methods used. Two new developments associated with policy analysis are discussed. One is the concern for deducing the effects of alternative policies before they are adopted, as contrasted to the traditional approach of evaluating policies before-and-after they have been adopted. Deductive modeling might be based on models of group, bilateral, or individual decision making. Examples from the field of criminal justice illustrate these three models. The second development is the concern for determining an optimum policy or combination of policies for achieving a given goal. This evaluative approach can be contrasted with the more common situation in which policies are taken as givens and the researcher attempts to determine the extent to which the desired effects are achieved. Various types of optimizing models are illustrated, again using legal issues as examples, such as determining an optimum policy level: (1) when doing too much or doing too little may be undesirable: (2) when scarce resources need to be allocated: and (3) among discrete alternatives, especially under conditions of uncertainty. (Author/GDC)

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WHAT CAN POLICY ANALYSIS ADD TO EVALUATION RESEARCH?: PREDICTIVE MODELING AND POLICY OPTIMIZATION

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Stuart S. Nagel
University of Illinois

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Abstract of

WHAT CAN POLICY ANALYSIS ADD TO EVALUATION RESEARCH?: PREDICTIVE MODELING AND POLICY OPTIMIZATION

Stuart Nagel, University of Illinois

(Evaluation Network Conference, 1979)

Policy analysis or policy studies can be broadly defined as the study of the nature, causes, and effects of alternative public policies. Sometimes policy analysis is more specifically defined to refer to the methods used in analyzing public policies. The main methods, however, are no different from those associated with social science and the scientific method in general, except that they are applied to variables and subject matters involving relations between policies, policy causes, and policy effects. In that sense, policy analysis is not something new methodologically. There are, however, at least two relatively new and exciting developments that are becoming increasingly associated with policy analysis which I would like to discuss.

One new development involves a concern for deducing the effects of alternative public policies before the policies are adopted, as contrasted to the more usual approach of quantitatively or non-quantitatively evaluating policies before-and-after they have been adopted. Deductive modeling involves drawing conclusions about the effects of policies from empirically tested premises, although the conclusions have not necessarily been empirically tested. Various types of deductive modeling might be involved in such deductions. One meaningful classification is to talk in terms of deductions based on (1) models of group decision-making, such as effects on conviction rates of changing the size of juries, (2) models of bilateral decision-making, such as the effects on the jail population of increased pretrial release which feeds through the plea bargaining system of criminal justice, and (3) models of individual decision-making, such as the effects on getting judges to comply with the presumption of innocence by publicizing their relative decisional propensities and other performance indicators.

A second new development involves a concern for determining an optimum policy or combination of policies for achieving a given goal or set of goals. This evaluative approach can be contrasted with the more common situation where policies are taken as givens and the researcher attempts to determine the extent to which they are achieving their desired effects. Various types of optimizing models exist. One meaningful classification is to talk in terms of (1) determining an optimum policy level where doing too much or too little may be undesirable, as in the problem of determining an optimum percentage of defendants to hold in jail prior to trial, (2) determining an optimum policy mix where scarce resources need to be allocated, as in the problem of allocating the resources of the Legal Services Program between law reform activities and routine case handling, and (3) determining an optimum choice among discrete alternatives especially under conditions of uncertainty, as in the problem of how to get jurors to decide cases more objectively and more in conformity with the law and the case facts.

The examples used mainly involve the legal process and legal policies, but one can easily reason by analogy to other policy problems. Both deductive modeling and optimization have wide potential applicability. What is especially needed are more researchers who are interested in developing that applicability for its theoretical and practical usefulness.

WHAT CAN POLICY ANALYSIS ADD TO EVALUATION RESEARCH?: PREDICTIVE MODELING AND POLICY OPTIMIZATION

All fields of scientific knowledge, but especially the social sciences, are now undergoing an increased concern for being relevant to important governmental policy problems. That increased concern has manifested itself in new articles, books, journals, book series, convention papers, organizations, courses, curricula, grants, job openings, and other indicators of academic activity.

The increased concern began especially in the late 1960's as part of the general public's concern for civil rights, the war on poverty, peace, women's liberation, environmental protection, and other social problems. The implementation of that concern was facilitated by the development and spread of computer software, statistical and mathematical methods, and interdisciplinary relations. The relative attractiveness of the government as an employer and sponsor also increased, as the role of universities in employment and research funding decreased.

Policy analysis or policy studies can be broadly defined as the study of the nature, causes, and effects of alternative public policies. Sometimes policy analysis is more specifically defined to refer to the methods used in analyzing public policies. The main methods, however, are no different from those associated with social science and the scientific method in general, except that they are applied to variables and subject matters involving relations among policies, policy causes, and policy effects. In that sense, policy analysis is not something new methodologically. There are, however, at least two relatively new and exciting developments that are becoming increasingly associated with policy analysis.

One new development involves a concern for deducing the effects of alternative public policies before the policies are adopted, as contrasted to the more usual approach of quantitatively or non-quantitatively evaluating policies before and after they have been adopted. Deductive modeling involves drawing conclusions about the effects of policies from empirically tested premises, although the conclusions have not necessarily been empirically tested. A second new development involves a

concern for determining an optimum policy or combination of policies for achieving a given goal or set of goals. This evaluative approach can be contrasted with the more common situation where policies are taken as givens and the researcher attempts to determine the extent to which they are achieving their desired effects.

The purpose of this paper is to present a few general principles concerning these new developments of deducing policy effects and of optimizing policy alternatives, and especially to present some illustrative examples. The examples are mainly taken from the criminal justice field, but one can see by analogy how the basic methods are applicable to a great variety of public policies.

I. DEDUCING THE EFFECTS OF POLICY CHANGES

A. GENERAL MATTERS

The main scientific alternative to deducing the effects of alternative public policies involves comparing people or places who have not experienced a certain policy with people or places who have experienced the policy. That approach has a number of methodological and normative defects. On a methodological level, there may be no places or not enough places which have adopted the policy. For example, a leading criminal justice controversy at the present time relates to whether flat sentencing should be adopted whereby legislatures specify the sentences to be administered to defendants convicted of certain crimes, and judges have no substantial discretion to deviate from those flat or fixed sentences. We cannot, however, use a purely empirical or observational approach to evaluate that policy proposal since almost none of the states has yet adopted it.

Comparing places which have and have not adopted a policy may also be impossible for the opposite reason, namely, that no places exist that do not have the policy, or that all the relevant places adopted the policy simultaneously. For example, in the controversial Miranda decision, the Supreme Court required all states

simultaneously to exclude the results of police interrogations where indigent defendants were not provided with requested counsel. No state had previously adopted that rule, and after the rule was adopted there was no control group for comparison purposes.

Along related lines, there are policies that have been adopted by some states or places and not others, but the adoption has involved non-random self-selection which tends to make comparisons virtually meaningless. For example, it may not be meaningful to compare murder rates in states that have capital punishment with those that lack capital punishment since there are so many other social characteristics that relate to murder rates besides capital punishment which may also relate to why some states have adopted capital punishment and others have not.

Another defect in the purely empirical approach is that the policy may have been adopted too recently for long-term evaluation. For example, the New Deal rural development program of the 1930's involved the government purchasing bankrupt plantations and large farms for redistributing parcels to small farmers under long-term, low-interest mortgages. The program was judged a failure because so many of the small farmers were unable to keep up the payments and lost their land. However, 30 years later in the 1960's, it was observed that the leaders of the voting rights movement in the Mississippi Delta were often older black farmers who had been among the recipients of the New Deal land redistribution, rather than young black militants. The older land-owning farmers fought for voting rights because they had more at stake in government programs and because they had less to fear with regard to losing their jobs. It took over 30 years though to observe that effect, and most academics are unwilling to wait that long to publish the results of a before-and-after evaluation.

Another methodological defect often present in making comparisons across places or over-time is that sufficient data may not be available for the before period rather than the after period,except in people's memories which may not be reliable. For example, in a study of the effects of the Supreme Court's 1961

decision requiring the exclusion from state criminal courtrooms of illegally-seized evidence, questionnaires were sent to police chiefs, prosecutors, judges, defense attorneys, and officials of the American Civil Liberties Union, asking before-and-after questions. One interesting finding was that police chiefs in states that had previously adopted the exclusionary rule often erred in thinking their states never had the rule and that it was imposed upon them by the Supreme Court. On the other hand, the ACLU officials in states that had not previously adopted the exclusionary rule often erred in thinking their states had always had the rule because they could not imagine their states could be so insensitive to fair procedure as to allow illegally-obtained evidence to be admissible in court.

The approach making comparisons across places or over time not only has methodological defects, but also important normative or socially-harmful defects even if the methodology were capable of accurately determining the effects of alternative public policies. One undesirable aspect of social experiments as a means of determining the effects of alternative policies is that once the policy is adopted, it is quite difficult to withdraw even if accurate evaluation shows the policy is ineffective or is producing undesirable consequences. This may possibly be the case with some aspects of the Law Enforcement Assistance Administration which has repeatedly been evaluated as being a relative waste of money in terms of crime reduction or other social indicators. Yet it continues to operate with little change in its methods, mainly because of the vested interests that have now been established on the part of federal, state, and local bureaucrats and grant recipients. The same may be true of farm programs that subsidize types of farming that other governmental evaluators have found to be socially undesirable, such as tobacco farming or farming that is dependent on alien and cheap migrant labor.

Even if a governmental policy that is found to be harmful after adopted is thereby terminated, considerable damage may already be done while the policy is in

existence. For example, changing from a 12-person jury to a 6-person jury may substantially increase the conviction rate before the increase is discovered if we have to adopt the 6-person jury in order to determine its effects. That increased conviction rate may mean the conviction of a number of innocent people who would otherwise not have been convicted. The damage done by those wrongful convictions cannot be set right by merely terminating the 6-person jury policy.

To avoid these methodological and normative defects of the traditional cross-sectional or time series analysis of policies or treatments, one can attempt to deduce the effects of policies from empirically-tested premises. That kind of deductive modeling generally takes one of three forms. It can be based on models dealing with group decision-making, models of bilateral decision-making, or models of individual decision-making. A simple illustration can be given of each kind of deductive modeling applied to policy analysis research.

B. DEDUCTIONS BASED ON A GROUP DECISION-MAKING MODEL

A good illustration of deductive modeling based on a group decision-making model involves attempting to determine the effects on conviction rates of changing from 12-person juries to 6-person juries. At first glance, one might think an appropriate way to determine that relation would be simply to compare the conviction rates in a state that uses 12-person juries with a state that uses 6-person juries. That approach is likely to be meaningless, however, because any differences we find in the conviction rates may be determined by other differences, such as the characteristics of the law, the people, or the cases in the two states or two sets of states, rather than by differences in their jury sizes.

As an alternative, one might suggest making before-and-after comparisons in a single state or set of states in order to control for those kinds of characteristics which do not generally change so much over short periods of time. If the conviction

rate before was 64 percent with 12-person juries, the conviction rate afterwards with 6-person juries might be substantially lower rather than higher, although most criminal attorneys would predict a higher conviction rate with 6-person juries. The conviction rate might, however, fall by virtue of the fact that if defense attorneys predict the 6-person juries are more likely to convict, then they will be more likely to plea bargain their clients and to bring only their especially pro-defendant cases before the 6-person juries. Thus, the nature of the new cases, not the change in jury size, would cause at least a temporary drop in the conviction rate, and there would be no way to hold constant the type of cases heard by the new 6-person juries.

As another alternative, one might suggest working with experimental juries, all of whom would hear exactly the same case. Half the juries would be 6-person juries and half would be 12-person juries. This experimental analysis, however, has the big defect that it involves a sample of only one case, no matter how many juries are used. Whatever differences or non-differences are found may be peculiar to that one case, such as being pro-prosecution, pro-defense, highly divisive, or simply unrealistic, and the results may thus not be generalizable. What is needed is about 100 different trial cases on audio or video tape, selected in such a way that 64 percent of them have resulted in unanimous convictions before 12-person juries and 36 percent in acquittals or hung juries, as tends to occur in real jury trials. It would, however, be too expensive a research design to obtain and play so many trials before a large set of 12-person juries and the same trials before a large set of 6-person juries, especially if the experiment lacks representative realism.

As an alternative to the cross-sectional, the before-and-after, and the simulation approaches, we could try a deductive approach to determine the impact of jury size on the probability of conviction. Figure 1 shows in a kind of syllogistic form how such a deduction might be made. The basic premise is the fact that

FIGURE 1. THE IMPACT OF JURY SIZE ON THE PROBABILITY OF CONVICTION

I. Basic Symbols

PAC = probability of an average defendant before an average *jury* being convicted (empirically equals .64 for a 12-person jury shown to two decimal places).

pac = probability of an average defendant receiving from an average *juror* a vote for conviction (empirically equals .577 for a juror shown to three decimal places).

II. Implications of the Coin-Flipping Analogy (Independent Probability Model)

$PAC = (pac)^{NJ}$.

$.64 = (pac)^{12}$, which deductively means the coin-flipping pac is .964.

III. Implications of the Bowling Analogy (Averaging Model)

PAC = pac.

.64 = pac, which deductively means the bowling pac is .640.

IV. Weighting and Combining the Two Analogies

Actual pac = [weight (coin-flipping pac) + (bowling pac)] / (weight + 1)

.577 = [weight (.964) + (.640)] / (weight + 1), which deductively means that the relative weight of the coin-flipping analogy to the bowling analogy is .13.

V. Applying the Above to a Six-Person Jury

PAC = [weight (coin-flipping PAC) + (bowling PAC)] / (weight + 1)

$PAC = [.13 (.964)^6 + (.64)] / 1.13$, which deductively means PAC with a 6-person jury is .66.

VI. Applying the Above to a Decision Rule Allowing Two of Twelve Dissenters for a Conviction

PAC = [weight (coin-flipping PAC) + (bowling PAC)] / (weight + 1)

PAC = [.13 (.99) + (.64)] / 1.13, which deductively means that PAC with a 10/12 rule is .58.

12-person juries tend to convict 64 percent of the time, and individual jurors on 12-person juries tend to vote to convict 67.7 percent of the time. If jury decision-making involved an independent probability model like coin-flipping, then individual jurors would vote to convict 96.4 percent of the time in order for 12-person juries to convict 64 percent of the time. If, on the other hand, jury decision-making involved an averaging model analogous to bowling where the 12 pins tend to stand or fall depending on what happens to the average pin, then individual voters would vote to convict 64.0 percent of the time in order for 12-person juries to convict 64 percent of the time. Since individual jurors actually vote to convict 67.7 percent of the time, that means jury decision-making is much more like the bowling model than the coin-flipping model, or to be more exact, it is about 1.00 to .13, or 8 to 1, more like the bowling model. That information and some simple calculations analogous to calculating a weighted average between the two models enables us to deduce (as Figure 1 shows) that if we switch from a 12-person jury to a 6-person jury and everything else remains constant, the conviction rate should rise from 64 percent to 66 percent.

The reason the conviction rate goes up so little when jury size is reduced from 12 to 6 is because jury decision-making is more like the bowling or averaging model than it is like the independent probability or coin-flipping model. The reason the conviction rate goes up at all is probably because non-convicting hung juries decrease with a 6-person jury since holdouts are less likely to have a fellow holdout for reinforcement than with a 12-person jury, and the number of reinforcing supporters is more important in maintaining a holdout than the number of opponents within the 6 to 12 range. Knowing the relation between jury size and conviction rates can in turn be relevant information as input into the empirical premises of an optimizing model designed to arrive at an optimum jury size that minimizes the weighted sum of type 1 errors (convicting the innocent) plus type 2 errors (not convicting the

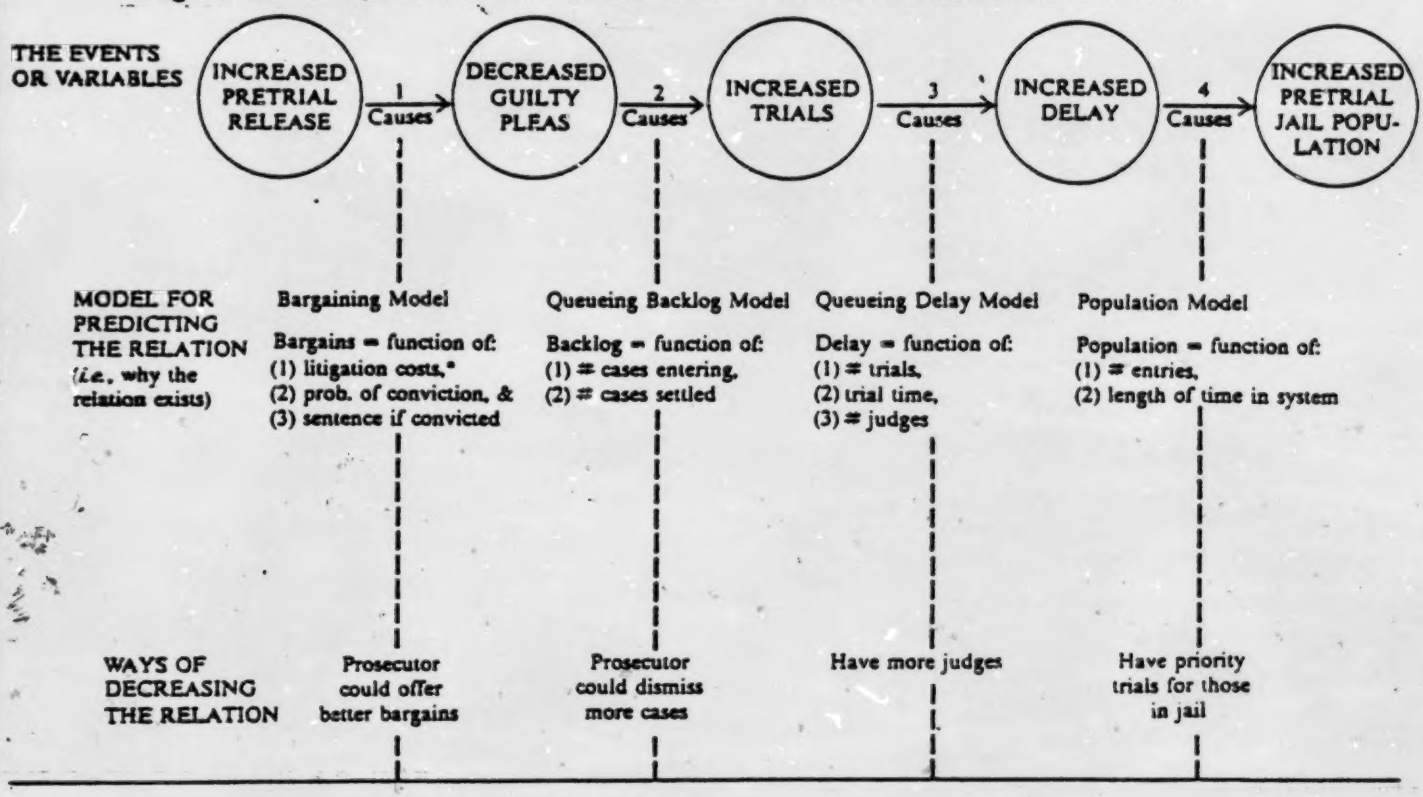
guilty). That, however, is a separate optimizing problem rather than a problem of deducing the effects of alternative policies.

C. DEDUCTIONS BASED ON A BILATERAL DECISION-MAKING MODEL

A good illustration of deductive modeling based on a two-sided, decision-making model involves attempting to determine the effect of increasing the pretrial release rate on the pretrial jail population. At first glance, one might logically jump to the conclusion that if pretrial release rates are increased, then of course the pretrial jail population will be decreased. That, however, is not necessarily so, as is shown in Figure 2. That figure shows an increase in pretrial release has the effect of decreasing guilty pleas by lowering a key cost that defendants otherwise often have to pay when they refuse to plead guilty, namely the cost of sitting in jail awaiting a trial. If more defendants are released prior to trial, they are less vulnerable to a prosecutor's promise in return for a plea of guilty to recommend a sentence equal to the time already served waiting in jail, or to recommend probation which will also mean the defendant can immediately get out of jail. Thus, a plea bargain is less likely to be struck since the probability of arriving at a bargain is at least partly a function of the costs to the litigants of not reaching an agreement or, in this context, of forcing a trial.

If there is a decrease in guilty pleas, there is likely to be an increase in trials, since a defendant pleading not guilty is in effect asking for a trial. If there is an increase in trials, there is likely to be increased delay in the system, since queueing models and common sense indicate that more trials mean more delay for those awaiting trial, in jail or out. If those awaiting trial in jail now have to wait longer, then the jail population will increase since it is a function of (1) the number of people going to jail which has gone down as a result of increased pretrial release, and (2) how long they stay there which has gone up because of the increased pretrial release and its intervening effects. That increase in jail length

Figure 2. THE IMPACT OF PRETRIAL RELEASE ON THE PRETRIAL JAIL POPULATION



*including the cost of sitting in jail awaiting trial

may more than offset the decrease in jail entries, thereby increasing rather than decreasing the pretrial jail population, all because of an increase in pretrial release.

It is interesting to note how each of the four relations of causal arrows at the top of Figure 2 is explained by a deductive model summarized in the middle of Figure 2. The first relation is explained by bargaining models which say that plea bargains arrived at are a function of the litigation costs, the probability of conviction, and the sentence if a conviction occurs, all as perceived by the defendant and the prosecutor. One of the defendant's most important litigation costs is the cost of possibly having to sit in jail awaiting trial if he demands a trial. By lowering that litigation cost, the defendant's upper limit to his offers is likely to be lowered, reducing the possibility that the defendant's upper limit will be above the prosecutor's lower limit, and thereby reducing the possibility of a settlement. The second relation is explained by the queueing model for determining backlog sizes, and the third relation is explained by the queueing model for determining the amount of delay or time consumption per case. The fourth relation involves a population model like that which says the world's population is a function of the number of births and how long people live. Likewise the jail population is a function of (1) the number of people entering the jail by not being released prior to trial which has gone down, and (2) how long the average detained defendant lives in the jail which has gone up.

It is especially interesting to note that each of those models not only predicts and explains the chain of relations from pretrial release to the size of the jail population, but each also suggests meaningful ways of lessening the extent to which those undesired relations occur, as is indicated at the bottom of Figure 2. The bargaining model suggests that the prosecutor could hold constant the percentage of guilty pleas even in the face of an increased pretrial release rate by making better offers to those who are released. The better offers might consist of shorter

sentences and more probation than the expected value of the sentence if convicted, discounted by the probability of being convicted. Even if the guilty plea rate goes down, the prosecutor can still hold constant the quantity of trials by dismissing more cases since he is under no obligation to prosecute just because the defendant pleads not guilty. Even if the quantity of cases increases, the amount of delay can be held constant by providing for more judges and other court personnel. If delay does increase, there need not be an increase in the length of time spent in jail awaiting trial if the prosecutor provides for priority trials to those who are in jail whereby their cases are tried ahead of defendants who are out of jail.

D. DEDUCTIONS BASED ON AN INDIVIDUAL DECISION-MAKING MODEL

A good illustration of deductive modeling based on an individual decision-making model involves attempting to determine the effect of publicizing judicial propensities on judicial behavior. More specifically, the law provides that when in doubt, a judge should release rather than hold a defendant in jail prior to trial. In reality, however, a judge stands to lose more by making the mistake of releasing a defendant who fails to appear for his court date or who commits a crime while released, than the judge stands to lose by making the mistake of holding a defendant who would appear without committing a crime while released. This is so because no one can tell in an individual case that a held defendant would have appeared without committing a crime since the held defendant is not given an opportunity to do so. Thus, the rational judge when in doubt may tend to hold rather than to release because his expected cost of holding is less than his expected cost of releasing. The deductive modeling problem involves determining the effect on judicial behavior of publicizing the holding rates of judges in light of this decision-making model.

If the holding rates of the judges serving in a given area are publicized, that is unlikely to bring those holding rates down. In other words, publicizing that the trial court judges in a given city hold 60 percent of all defendants in jail

pending trial will not cause any individual judge to decrease his holding because publicizing that information does not increase his expected costs of holding. Likewise, publicizing the holding rates for each individual judge on the court is not likely to lower the holding rates of the high holders because they can justify at least to themselves that their high holding is needed in order to decrease non-appearances and crime-committing by defendants released prior to trial. If, however, the holding rates of individual judges are publicized along with the appearance rates and non-crime-committing rates they achieve among the defendants they release, then the high holders might come down.

This might be so because empirical studies show that holding rates do vary greatly across judges, but appearance and non-crime-committing rates tend to be almost uniformly high among both high-holding and low-holding judges. Thus, Judge Jones, who holds 80 percent of all defendants, may look bad in comparison with his fellow judges like Judge Smith, who holds only 30 percent of all defendants. But each is likely to have about a 90 to 95 percent appearance rate and non-crime-committing rate for those defendants they release. In other words, it looks as if Judge Jones is holding 50 percent more defendants than he needs to hold in order to have a 90 to 95 percent appearance and non-crime-committing rate, even though we cannot tell in which cases Judge Jones has made a holding error. That kind of publicizing thereby increases the expected cost of holding to Judge Jones, and is likely to cause him to decrease his holding if everything else remains constant. That effect can be further accentuated by also publicizing the undesirable effects and high social costs incurred by holding defendants in jail, such as jail maintenance, lost gross national product, increased families on welfare, jail congestion, and the frequency of held defendants being found not guilty, or only guilty of crimes involving sentences shorter than the jail time already served awaiting trial.

The same individual decision-making model can be used to deduce the effects of other changes on decreasing the decision to hold. The expected cost of holding relative to releasing is likely to go down if one decreases the costs of releasing by

such means as making rearrests more easy through pretrial supervision or decreasing the time from arrest to trial, thereby lessening the time to disappear or commit crimes. The expected cost of releasing also goes down if the probability of appearance and non-crime-committing can be increased through such means as better screening and notification and more vigorous prosecution of those who fail to appear.

II. OPTIMIZING ALTERNATIVE PUBLIC POLICIES

A. GENERAL MATTERS

The main scientific alternative to optimizing alternative public policies is the perspective that takes policies as givens and attempts to determine their effects. This is often referred to as impact analysis or evaluation research. An optimizing perspective, on the other hand, takes goals as givens and attempts to determine what policies will maximize those goals.

On a highly general level, the best or optimum policy or set of policies is the one that maximizes benefits minus costs, subject to economic, legal, political, or other constraints. Models for optimizing alternative public policies can be classified in terms of whether they involve finding (1) an optimum policy level where doing too much or too little may be undesirable, (2) an optimum policy mix where scarce resources need to be allocated, or (3) finding an optimum policy choice among discrete alternatives, especially under conditions of uncertainty.

In optimum level problems, one needs to relate adoption costs and non-adoption costs to various policy levels. The optimum policy level is then the level or degree of adoption that minimizes the sum of the adoption costs plus the non-adoption costs. In optimum mix problems, one needs to determine the relative slopes or marginal rates of return of each of the places or activities under consideration. If linear relations are present, the optimum mix is then the mix or allocation that gives all of the budget to the most productive places or activities subject to the constraints. If diminishing returns are assumed, the optimum mix is th. one that allocates the

budget in such a way that the marginal rates of return are equalized across the places or activities so that nothing can be gained by redistributing the budget. In optimum choice problems, one needs to determine the benefits and costs from each choice. The optimum choice is then the one that has the highest benefits minus costs with the benefits and costs being discounted by the probability of their being received.

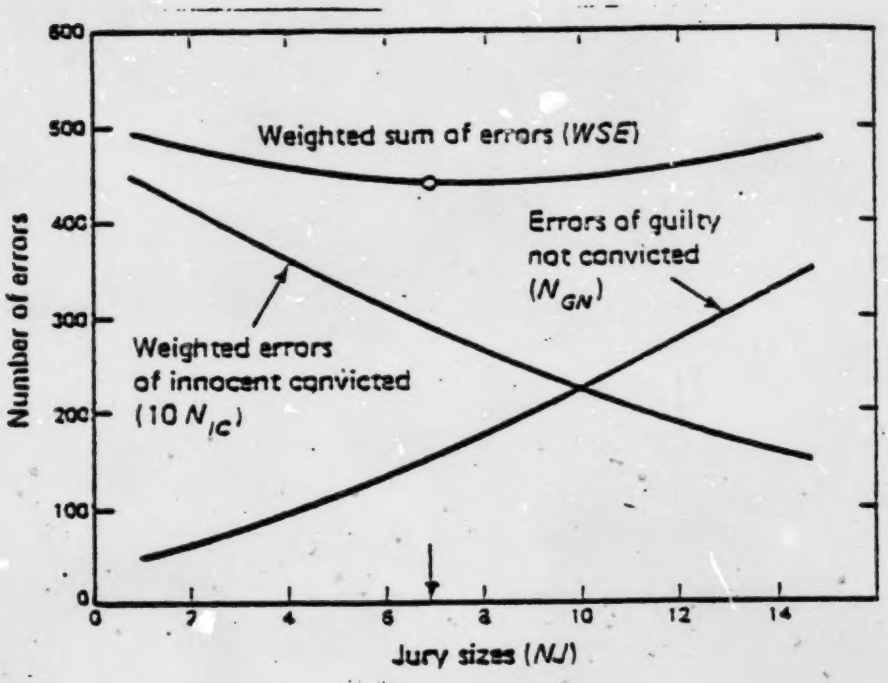
These general concepts and principles can be greatly clarified by providing a concrete illustration for each of the three major types of optimizing models with regard to determining an optimum level, mix, or choice.

B. DETERMINING AN OPTIMUM POLICY LEVEL

A good illustration of finding an optimum policy level is the problem of what is the optimum size jury. That problem is one being faced by many states which have lowered or contemplated the lowering of jury sizes from 12 to 6 or even 5, in order to save the time and money which 12-person juries supposedly incur. The United States Supreme Court has heard a number of cases in which defendants have questioned the constitutionality of juries smaller than 12 persons. In the 1978 case of Ballew v. Georgia, the Supreme Court favorably referred to some of the policy analysis literature which has attempted to analyze not only the effects on conviction rates of changing jury sizes, but also to analyze what an optimum jury size might be.

Knowing the relation between jury size and conviction rates can be used as input into the empirical premises of an optimizing model designed to arrive at an optimum jury size that minimizes the weighted sum of type 1 errors of convicting the innocent, plus type 2 errors of not convicting the guilty. Figure 3 summarizes what is involved in that kind of analysis. The curve of "weighted errors of innocent convicted" was arrived at by using the analysis of Figure 1, but operating on the tentative assumption that a 12-person jury would be likely to convict an innocent person only about 40 percent of the time rather than 64 percent, and that about 5 out of 100 defendants tried by juries may be actually innocent. The curve of "errors

FIGURE 3. GRAPHING THE NUMBER OF ERRORS FOR VARIOUS JURY SIZES



of guilty not convicted' was arrived at with the tentative assumption that a 12-person jury would be likely to convict a guilty person about 70 percent of the time rather than 64 percent, and that about 95 out of 100 defendants tried by juries are probably actually guilty.

The 'weighted sum of errors' curve was calculated by simply summing the other two curves after multiplying the points on the first curve by 10 to indicate that convicting the innocent is traditionally considered 10 times as bad as not convicting the guilty. With those tentative assumptions and that analysis, the weighted sum of errors bottoms out at jury sizes between 6 and 8. Justice Blackmun in announcing the Court's decision referred favorably to that analysis in deciding that it was meaningful to allow juries to be smaller than 12 but no smaller than 6.

In his opinion in the Ballew case, Justice Blackmun indicated agreement with the analysis in Figure 1 and the 10-to-1 trade-off weight. The model, however, is not particularly sensitive to that trade-off weight in the sense that the weight can be reasonably varied and the weighted errors curve will still bottom out at about 7. The model, however, is particularly sensitive to the assumption that prosecutors operate at a .95 level of confidence in deciding whether a defendant is guilty such that he can be brought to trial. If prosecutors are operating substantially below a .95 level, then one would need larger juries to protect those additional innocent defendants from being convicted. If prosecutors are operating substantially above a .95 level, then one could have smaller juries to increase the probability of convicting those additional guilty defendants.

Thus the optimum jury size mainly depends on what assumption one is willing to make regarding how many jury-tried defendants out of each 100 are truly guilty. People who favor 12-person juries probably perceive the number of innocent jury-tried defendants as being greater than the number perceived by people who favor 6-person juries. Thus the optimum jury size ultimately depends on normative values, rather than observed relations or relations deduced from empirical premises.

Nevertheless, the combination of the predictive model of Figure 1 and the optimizing model of Figure 2 enable us to see better what is involved in choosing among alternative jury sizes. The same analysis can be applied to choosing among alternative fractions required to convict such as unanimity, a 10/12 rule, or a 9/12 rule.

C. DETERMINING AN OPTIMUM POLICY MIX

A good illustration of finding an optimum policy mix is the problem of what is the optimum allocation between law reform activities and routine case handling in the legal services agencies funded by the Office of Economic Opportunity. The average legal services agency in 1971 had $67 to spend per client. Of that $67, not less than 10 percent could be spent on law reform activities, and not less than 80 percent could be spent on routine case handling according to the general policies of the national office. The question thus is how to allocate the $67 per client in such a way as to maximize the satisfaction of the program evaluators, or how to minimize expenditures while providing a minimum level of satisfaction.

To obtain the optimum mix, one could determine for each of a number of legal services agencies (1) the overall satisfaction score it received in the 1971 evaluations, (2) the number of dollars it spent per client on law reform activities, and (3) the number of dollars it spent per client on case handling activities. One could then fit an equation to that data through the use of linear regression analysis. That equation tells us the relation between satisfaction on the one hand and law reform and case handling on the other, especially if we statistically hold constant other variables that might influence satisfaction. Such an equation indicates that law reform has a higher slope or rate of return than case handling. With that finding, one can say the optimum mix for <u>maximizing satisfaction</u> is to give the minimum constraint to case handling and the rest of the budget per client to law reform. One can also say the optimum mix for <u>minimizing expenditures</u> is to give the minimum constraint to case handling and the rest of the budget per client to law reform, but

just up to the point where a satisfaction score of 7 is obtained since that score was considered to represent a minimum satisfaction level.

The actual average allocation was substantially less efficient than either of the above optimums because many conservative legal services agencies felt such an emphasis on law reform would get them into trouble with the national office as of 1971, and many liberal legal services agencies that were dominated by a client orientation felt law reform was not what the individual clients wanted. The evaluators or the other hand tend to be prominent lawyers who had a high regard for the technical competence needed to do law reform work like appellate case argument, and not such a high regard for the relative lack of competence needed to do much routine case handling like default divorce cases, regardless whether the lawyers had conservative or liberal backgrounds. If the evaluators had included more low-income clients rather than lawyers, the slope of law reform may have become lower than the slope of case handling in the regression equation that was developed from the agency-by-agency data. The optimum mix, however, would still be the same if the law reform slope were decreased but still higher than the case handling slope, given the linear nature of the data for the somewhat narrow range of discretionary allocation.

D. DETERMINING AN OPTIMUM POLICY CHOICE

A good illustration of finding an optimum policy choice is the problem of how a juror should vote with regard to convicting or acquitting a given defendant, and how jurors should be instructed in order to maximize objectivity across jurors and conformity with the principle that convictions should only occur if the defendant is guilty beyond a reasonable doubt.

A rational juror should vote to convict or acquit depending on which choice will give him or her the highest expected value, although expected value calculations are done implicitly rather than explicitly. The expected value of each choice equals the perceived benefits minus costs, discounted by the probability of their being

received. The probability in this context is the probability of the defendant actually being guilty. To obtain the highest expected value, a juror should vote to acquit if the perceived probability of guilt is below a threshold probability, and vote to convict if the perceived probability of guilt is above a threshold probability. The threshold probability can be determined by knowing the relative value a juror places on avoiding the conviction of an innocent defendant versus the acquittal of a guilty one.

To stimulate jurors to have a common threshold probability, and a high threshold probability in the .90's in accordance with the law, jurors can be instructed that it is considered ten times as undesirable to convict an innocent defendant as it is to acquit a guilty one (i.e, the 10-to-1 trade-off instruction). Merely instructing them that the standard of guilt is 'beyond a reasonable doubt" or that a conviction requires a .90 probability does not generate a common or high threshold probability. For example, male and female students at the University of Illinois were given diverse instructions on how to decide criminal cases, and then their threshold probabilities in rape cases were determined by asking them questions about their relative satisfaction or dissatisfaction from convicting a guilty defendant, convicting an innocent defendant, acquitting a guilty defendant, or acquitting an innocent defendant. The results were roughly as follows:

TYPE OF JURY INSTRUCTION	THRESHOLD PROBABILITIES (in rape cases)	
	Males	Females
No Instruction	.65	.45
Beyond Reasonable Doubt	.75	.60
.90 Probability	.85	.75
10-to-1 Tradeoff	.90	.90

With no instruction, there is considerable divergence between the two groups and both groups are substantially below the desired .90 threshold probability. A verbal

instruction increases both objectivity and conformity with the law, but not enough. A quantitative instruction makes for an improvement, but not as much as the 10-to-1 tradeoff instruction.

Although the optimum choice seems to be the 10-to-1 instruction, the empirical reality is generally no instruction. The difference between the empirical and the optimum here may possibly be caused by judges being aware that a 10-to-1, .90, or verbal instruction will make convictions more difficult to obtain which they do not want to do. In other words, judges have decided on the no-instruction choice, and we assume they perceive that convictions will be more difficult to obtain by giving the recommended instructions. We thereby deduce that their values must generally be oriented toward keeping the conviction rate up, since there seems to be no other deduced value position capable of reconciling the decision reached with the assumed factual perception. This illustrates how optimizing analysis can often relate back to making deductions about decision-making behavior, just as deductions about decision-making behavior can often serve as the premises for an optimizing model.

III. SOME CONCLUSIONS

These two dimensions of deducing effects of policy changes and optimizing alternative public policies represent two of the newest and most interesting aspects of policy analysis research. Although they have an element of newness to them, they both relate back to a traditional social philosophy concern for logical and normative analysis quite prevalent in the writings of such classical social philosophers as Aristotle, Saint Thomas Aquinas, and other pre-twentieth century thinkers. They also relate back to a more recent behavioral science concern for quantifying relationships which has been quite prevalent in the post-World War II social science literature. Policy analysis research thus represents a kind of synthesis of classical social

philosophy and modern behavioral science as applied to important policy problems.

Policy analysis also represents an interdisciplinary synthesis of methodological and conceptual contributions from such disciplines as economics, business administration, industrial engineering, and social psychology. Political science and public administration also contribute a perspective that emphasizes the need to consider problems of policy adoption, implementation, and political philosophy. The examples we have presented come from the substance of legal policy problems, but one can easily reason by analogy to policy problems from a broad variety of substantive fields. Both deductive modeling and optimization have wide potential applicability. What is especially needed now are even more researchers who are interested in developing that applicability for its theoretical and practical usefulness.

SUGGESTED READINGS

A. POLICY ANALYSIS RESEARCH IN GENERAL

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3. S. Nagel and M. Neef, Policy Analysis: In Social Science Research (Sage, 1979).

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5. Edith Stokey and Richard Zeckhauser, A Primer for Policy Analysis (Norton, 1978).

B. CRIMINAL JUSTICE POLICY ANALYSIS

1. Haig Bohigan, The Foundations and Mathematical Models of Operations Research with Extensions to the Criminal Justice System (Gazette Press, 1971).

2. Sidney Brounstein and Murray Kamrass (eds.), Operations Research in Law Enforcement, Justice, and Societal Security (Lexington-Heath, 1976).

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4. S. Nagel and M. Neef, The Legal Process: Modeling the System (Sage, 1977) Legal Policy Analysis: Finding an Optimum Level or Mix (Lexington, 1977) and Decision Theory and the Legal Process (Lexington, 1979).

5. Gordon Tullock, The Logic of the Law (Basic Books, 1971).